

Patent Claims

=====

5 1. An optical system, in particular projection exposure system for microlithography, in particular having a slot-shaped image field or non-rotational-symmetric illumination,

10 a) having an optical element comprising at least one chamber that is sealed from atmospheric pressure and is enclosed by boundary surfaces and that has a fluid filling, wherein at least one of the boundary surfaces is exposed at least partially by illumination light;

15 b) fluid source that has a fluid connection to the chamber via a fluid supply line; and

20 c) control device for the pressure of the liquid filling;

wherein

25 the at least one enclosed chamber (5; 105, 105') is configured in such a way that a change in the fluid pressure inside the at least one chamber (5; 105, 105') results in a change in non-rotational-symmetric imaging properties of the optical element (1; 101) that have an n-fold symmetry relative to the optical axis of the optical element, where n is greater

30 than 1.

35 2. The optical system as claimed in claim 1, wherein a change in the fluid pressure inside the at least one chamber (5; 105, 105') results in a change in the astigmatic imaging properties of the optical element (1; 101).

- 4 3. The optical system as claimed in claim 1 or 2, wherein
at least that region of the surfaces forming the
boundary of the chamber (5) that is irradiated by
illumination light is at least partially formed by an
5 elastically deformable material (3, 4), the edge
contour (9, 10) of the elastically deformable region
being non-rotational-symmetric.
- 10 4. The optical system according to claim 3, wherein the
edge contour (9, 10) has an n-fold symmetry relative
to the optical axis of the optical element, where n is
greater than 1.
- 15 5. The optical system as claimed in claim 4, wherein the
edge contour (9, 10) is elliptically shaped.
6. The optical system as claimed in claim 4, wherein the
edge contour has the shape of a polygon.
- 20 7. The optical system according to ^{claim 3} ~~one of claims 3 to 6~~,
characterized in that the elastically deformable
optical medium (3, 4) is held in its edge region by a
holding device (6, 11, 7, 12), the shape of the
holding surface with which the optical medium (3, 4)
25 is in contact with the holding device (6, 11, 7, 12)
imposes the edge contour (9, 10) of the elastically
deformable surface region.
8. The optical system as claimed in claim 7, wherein the
30 optical medium is a pellicle (3, 4).
9. The optical system as claimed in claim 7, wherein the
optical medium is a quartz plate.
- 35 10. The optical system as claimed in claim 7, wherein the
optical medium is a CaF_2 plate.

Handwritten signature and stamp on the left margin.

4 11. The optical system as claimed in ^{claim 3} ~~one of claims 3 to~~
4 ~~10~~, wherein the optical medium has a reflecting
coating.

Q 5 12. The optical system as claimed in claim 1 ~~or 2~~, wherein
at least one region of a surface of the surfaces
forming the boundary of the chamber (105, 105') is
irradiated by illumination light (148) and is formed
by at least one rigid optical surface having different
curvature in mutually perpendicular planes.

10
15
20
25
30
35
13. The optical system as claimed in claim 12, wherein the
optical element (101) is formed from a combination of
at least two optical components (127, 128) that each
comprise at least one chamber (105, 105') that is
sealed from atmospheric pressure and is enclosed by
boundary surfaces, that has a liquid filling and that
is irradiated by illumination light (148), the optical
components (127, 128) having, at least in the region
of one surface of the surfaces forming the boundary of
the respective chambers (105, 105') in each case at
least one optical surface having different curvature
in mutually perpendicular planes; and wherein an
independent control of the pressure of the liquid
filling in the chambers (105, 105') assigned to the
optical components (127, 128) is ensured by means of a
control device (147).

14. The optical system as claimed in claim 13, wherein the
optical element is designed so that, given equal
pressure in the fluid filling in the chambers (105,
105') assigned to the optical components, it has
essentially rotational-symmetric imaging properties.

15. The optical system as claimed in claim 12, wherein the
optical element is designed so that, given equal
pressure in the fluid filling in the chambers (105,

105') assigned to the optical components, it has astigmatic imaging properties.

- 9 16. The optical system as claimed in ^{claim 12} ~~one of claims 12 to~~
 4 5 ~~15~~, wherein the optical surface having different
 curvature in mutually perpendicular planes is a
 surface of a cylindrical lens (130, 130').
- 10 17. The optical system as claimed in claim 16, wherein the
 cylindrical lens (130, 130') is a plano-convex
 cylindrical lens.
- 9 18. The optical system as claimed in ^{claim 1} ~~one of the preceding~~
 4 ~~claims~~, wherein the control device (22; 147) has a
 15 signal connection (23, 24, 25; 123, 124, 125) to a
 sensor arrangement (26; 126) that monitors the imaging
 properties of the optical element (1; 101) and/or the
 optical system, the control device (22; 147)
 20 impressing a pressure in the fluid filling as a
 function of the transmitted signal data of the sensor
 arrangement (26; 126).
19. The optical system as claimed in claim 18, wherein the
 25 sensor arrangement (26; 126) has a position-sensitive
 sensor.
20. The optical system as claimed in claim 19, wherein the
 position-sensitive sensor (26; 126) is a CCD array.
- 9 30 21. The optical system as claimed in ^{claim 1} ~~one of the preceding~~
 a ~~claims~~, wherein the control device (22; 147) is
 designed so that it is capable of producing both
 underpressures and overpressures.
- 9 35 22. The optical system as claimed in ^{claim 1} ~~one of the preceding~~
 a ~~claims~~, wherein the fluid is a gas.

23. The optical system as claimed in claim 22, wherein the fluid is a noble gas.

Q 24. The optical system as claimed in ^{claim 1} ~~one of claims 1 to~~
Q 5 ~~21~~, wherein the fluid is a liquid.